I. "Sixth Memoir on Radiation and Absorption." By Prof. J. Tyndall, F.R.S. Received December 21, 1865.

(Abstract.)

In this paper the author considers the deportment of certain additional elementary bodies towards Radiant Heat. He exposes powders and liquids of the same physical character, but differing from each other chemically, at a focus of dark rays, and describes the different effects produced. He examines and explains the experiments of Franklin on the absorption of solar heat. He then determines the radiative power of a great number of substances in the state of fine powder, and finds, contrary to the current belief, that in this state also chemical constitution exercises a paramount influence. The results obtained by previous experimenters in connexion with this subject are illustrated and explained. The reciprocity of radiation and absorption on the part of fine powders is also illustrated. It is moreover shown that the heat emitted from different sources, at a temperature of 100° C., varies in quality, this being proved by its unequal transmission through plates of rock-salt of perfect purity. The absorption by such plates varies from 4 to 30 per cent. of the incident radiation.

II. "On the Spectrum of Comet 1, 1866." By William Huggins, F.R.S. Received January 11, 1866.

The successful application of prismatic analysis to the light of the nebulæ showed the great importance of subjecting the light of comets to a similar examination, especially as we possess no certain knowledge of the intimate nature of those singular and enigmatical bodies, or of the cosmical relations which they sustain to our system. The importance of a prismatic analysis of cometary light is enhanced by the consideration of the general resemblance which some of the nebulæ present to the nearly round vaporous masses of which some comets, in some positions at least in their orbits, appear to consist,—a resemblance which suggests the possible existence of a close relation between nebulous and cometary matter.

I made several unsuccessful attempts to obtain a prismatic observation of Comet 1, 1864. The position of the comet and the weather were unfavourable. M. Donati succeeded in making an examination of the spectrum of this comet. "It resembles," says M. Donati, "the spectra of the metals; in fact the dark portions are broader than those which are more luminous, and we may say these spectra are composed of three bright lines"*.

Yesterday evening, January 9, 1866, I observed the spectrum of Comet

* Monthly Notices, Royal Astronomical Society, vol. xxv. p. 114.

1, 1866. The telescope and spectrum-apparatus which I employed are described in my paper "On the Spectra of some of the Nebulæ" *.

The appearance of this comet in the telescope was that of an oval nebulous mass surrounding a very minute and not very bright nucleus. The length of the slit of the spectrum-apparatus was greater than the diameter of the telescopic image of the comet.

The appearance presented in the instrument when the centre of the comet was brought nearly upon the middle of the slit, was that of a broad continuous spectrum fading away gradually at both edges. These fainter parts of the spectrum corresponded to the more diffused marginal portions of the comet. Nearly in the middle of this broad and faint spectrum, and in a position in the spectrum about midway between *b* and F of the solar spectrum, a bright point was seen. The absence of breadth of this bright point in a direction at right angles to that of the dispersion showed that this monochromatic light was emitted from an object possessing no sensible magnitude in the telescope.

This observation gives to us the information that the light of the coma of this comet is different from that of the minute nucleus. The nucleus is self-luminous, and the matter of which it consists is in the state of ignited gas. As we cannot suppose the coma to consist of incandescent solid matter, the continuous spectrum of its light probably indicates that it shines by reflected solar light.

Since the spectrum of the light of the coma is unlike that which characterizes the light emitted by the nucleus, it is evident that the nucleus is not the source of the light by which the coma is rendered visible to us. It does not seem probable that matter in the state of extreme tenuity and diffusion in which we know the material of the comæ and tails of comets to be, could retain the degree of heat necessary for the incandescence of solid or liquid matter within them. We must conclude, therefore, that the coma of this comet reflects light received from without; and the only available foreign source of light is the sun†. If a very bright comet were to visit our system, it might be possible to observe whether the spectra of the coma and the tail contain the dark lines which distinguish solar light. If the continuous spectrum of the coma of Comet 1, 1866, be interpreted to indicate that it shines by reflecting solar light, then the prism gives no information of the state of the matter which forms the coma, whether it be solid, liquid, or gaseous. Terrestrial phenomena would suggest that the parts of a comet which are bright by reflecting the sun's light, are probably in the condition of fog or cloud.

* Phil. Trans. 1861, p. 421.

† This conclusion is in accordance with the results of observations on the polarization of the light of the tails of some comets. Some of these observations appear to have been made with the necessary care. See J. P. Bond's "Account of the Great Comet of 1858," Annals of the Astronomical Observatory of Harvard College, vol. iii. pp. 305–310.

We know, from observation, that the comæ and tails of comets are formed from the matter contained in the nucleus.

The usual order of the phenomena which attend the formation of a tail appears to be that, as the comet approaches the sun, material is thrown off, at intervals, from the nucleus in the direction towards the sun. This material is not at once driven into the tail, but usually forms in front of the nucleus a dense luminous cloud, into which for a time the bright matter of the nucleus continues to stream. In this way a succession of envelopes may be formed, the material of which afterwards is dissipated in a direction opposite to the sun, and forms the tail. Between these envelopes dark spaces are usually seen.

If the matter of the nucleus is capable of forming by condensation a cloud-like mass, there must be an intermediate state in which the matter ceases to be self-luminous, but yet retains its gaseous state, and reflects but little light. Such a non-luminous and transparent condition of the cometary matter may possibly be represented by some at least of the dark spaces which, in some comets, separate the cloud-like envelopes from the nucleus and from each other.

Several of the nebulæ which I have examined give a spectrum of one line only, corresponding in refrangibility with the bright line of the nucleus of the comet referred to in this paper. Other nebulæ give one and two fainter lines besides this bright line. Whether either or both of these were also present in the spectrum of this comet I was unable to determine. The light of the comet was feeble, and the presence of the continuous spectrum made the detection of these lines more difficult. I suspected the existence of the brighter of these lines. I employed different eyepieces, and also gave breadth to the bright point by the use of the cylindrical lens, but I was not able to obtain satisfactory evidence of more lines than the bright one already described.

In my paper "On the Spectra of the Nebulæ," I showed that this bright line corresponds in refrangibility with the brightest of the lines of nitrogen. This line may perhaps be interpreted as an indication that cometary matter consists chiefly of nitrogen, or of a more elementary substance existing in nitrogen.

The great varieties of structure which may exist among comets, as well as the remarkable changes which the same comet undergoes at different epochs, will cause all those who are interested in the advance of our knowledge of the cosmical relations of these bodies, and of the gaseous nebulæ, to wait with some impatience the visit of a comet of sufficient splendour to permit a satisfactory prismatic examination of the physical state of cometary matter during the various changes which are dependent upon the perihelion passage of the comet.